

Application No. 10/787,449
Response to Office Action

Customer No. 01933

Amendments to the Specification:

Please amend the paragraph at page 1, lines 8-23 as follows:

Generally, an antenna apparatus of the type comprises a dielectric substrate, a flat-plate radiation element disposed on the dielectric substrate, and a feeding lead connected to the radiation element and extracted outward through the dielectric substrate. Such antenna apparatus is disclosed, for example, in Japanese Patent Application Publication (JP-A) No. 2002-198725. Referring to Fig. 1, this antenna apparatus comprises a flat-plate radiation element 11 of a generally square shape disposed on ~~a front~~ an upper surface of a dielectric substrate 12 of a generally rectangular shape, a one-point feeding member 13 located at an offset position of the radiation element 11, and a grounding conductor member 14 having a generally rectangular shape and attached throughout an entire region of a ~~rear~~ lower surface of the dielectric substrate 12. Although not shown in the figure, a ground electrode is adhered to the grounding conductor member 14. A combination of the radiation element 11 and the dielectric substrate 12 forms a patch antenna. With the above-mentioned structure, it is possible to set the best axial ratio for a signal frequency of a circular polarization signal to be transmitted and received.

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Please amend the paragraph at page 2, lines 1-11 as follows:

Another existing antenna apparatus is disclosed, for example, in Japanese Patent Application Publication (JP-A) No. 2002-237714. As shown in Fig. 2, this patch antenna comprises a flat-plate radiation element 21 disposed on an insulation substrate 22, a feeding member 23 located at an offset position, a ground conductor 24 disposed throughout an entire region of ~~a front~~ an upper surface of the insulation substrate 22, and a dielectric member 25 placed on the ground conductor 24 at a position where an electric field strength is weak. The radiation element 21 is spaced from the ground conductor 24 by the presence of the dielectric member 25 interposed therebetween. With the above-mentioned structure, it is possible to obtain a patch antenna with higher gain.

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Please amend the paragraph at page 2, lines 18-23 as follows:

As shown in Figs. 3 and 4A and 4B, the antenna apparatus comprises a radiation element 31 disposed on a ~~front~~ an upper surface of a dielectric substrate 32, a feeding lead 33 located at an offset position of the radiation element 31, and a ground conductor 34 attached to a ~~rear~~ lower surface of the dielectric substrate 32. The feeding lead 33 passes through the dielectric substrate 32 and the ground conductor 34 to protrude outward.

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Please amend the paragraph at page 4, lines 16-23 as follows:

According to the present invention, ~~there is provided~~ an antenna apparatus is provided which has an integral structure and which comprises a flat-plate radiation element (31) buried in a dielectric substrate (42, 52) at its center portion, and a conductor cover (44, 54) having side wall portions extending in a thickness direction of the radiation element (31) and covering all of side surfaces of the dielectric substrate and hood portions (44W, 54W) extending from upper edges of the side wall portions and covering a part of ~~a front~~ an upper surface of the dielectric substrate.

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Please amend the paragraph at page 4, line 24 to page 5,
line 2 as follows:

According to one aspect of the present invention, each of the hood portions (44W) has a trapezoidal shape whose base is coincident with a peripheral side of the ~~front~~ upper surface of the dielectric substrate (42). The hood portions partially cover the ~~front~~ upper surface of the dielectric substrate (42) so as to leave an exposed portion having a rectangular center portion and a plurality of strip-like peripheral portions extending outward from four corners of the rectangular center portion along diagonal lines.

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Please amend the paragraph at page 5, lines 3-9 as follows:

According to a different aspect of the present invention, each of the hood portions (54W) has a rectangular shape whose base is coincident with a peripheral side of the front upper surface of the dielectric substrate (52). The hood portions partially cover the front upper surface of the dielectric substrate (52) so as to leave an exposed portion having a rectangular center portion and a plurality of rectangular peripheral portions with their inner corners overlapping four corners of the rectangular center portion, respectively.

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Please amend the paragraph at page 6, lines 14-26 as follows:

Referring to Figs. 6A and 6B, an antenna apparatus according to a first embodiment of this invention comprises a flat-plate radiation element 31, a dielectric substrate 42, a feeding lead 43, and a conductor cover 44. The radiation element 31 is buried in the dielectric substrate 42 at its center portion. The dielectric substrate 42 is made of a dielectric material, such as a polytetrafluoroethylene, and has a rectangularly configured body. The dielectric substrate 42 completely encloses the radiation element 31. The feeding lead 43 serves to energize the radiation element 31. The feeding lead 43 is connected to the radiation element 31 at an offset position on the plane of the radiation element 31 and is extracted outward (downward in the figure) from a rear lower surface of the dielectric substrate 42. Although not shown in the figure, a ground conductor is attached to the rear lower surface of the dielectric substrate 42 and penetrated by the feeding lead 43.

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Please amend the paragraph at page 6, line 27 to page 7,
line 10 as follows:

The conductor cover 44 as a characteristic part of the present invention has four side wall portions and four hood portions 44W. The side wall portions extend in a thickness direction of the radiation element 31 and cover all of side surfaces of the dielectric substrate. The four hood portions 44W extend from upper edges of the side wall portions and cover a part of the ~~front~~ upper surface of the dielectric substrate 42. Each of the hood portions 44W has a trapezoidal shape extending from each of upper edges of the side wall portions and covers a part of the ~~front~~ upper surface of the dielectric substrate 42. Except those parts covered by the hood portions 44W, the ~~front~~ upper surface of the dielectric substrate 42 has an exposed portion having a generally square center portion and four strip-like peripheral portions extending outward from four corners of the square center portion along diagonal lines.

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Please amend the paragraph at page 7, lines 13-27 as follows:

The radiation element 31 is placed inside the dielectric substrate 42 at its center portion and has, on an X-Y plane, a six-sided or a hexagonal shape as described in conjunction with Fig. 5A. The radiation element 31 has a maximum width or transversal length L_p of about 47.7mm. The distance h_p between a rear lower surface of the radiation element 31 and the rear lower surface of the dielectric substrate 42 is equal to about 2.6mm. On each side of the front upper surface of the dielectric substrate 42, the length ΔL of the cut portion is equal to about 10.6mm. The dielectric substrate 42 has a square shape on the X-Y plane and has a side length L_w of about 63.6mm and a thickness h_w of about 5.1mm in a Z axis direction. The feeding lead 43 is placed on the radiation element 31 at a position d_f spaced by about 14.1mm from a center point in an X axis direction. Each of the hood portions 44W of a trapezoidal shape has a width W of about 12.8mm and a bottom length $(L_w - d_w \times 2)$ shorter than the side length L_w (63.6mm) of the dielectric substrate 42 by twice the length d_w of about 8mm.

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Please amend the paragraph at page 8, lines 1-9 as follows:

The above-mentioned components are formed into an integral structure. The integral structure may further include a ground conductor or a ground electrode fixedly attached to the ~~rear~~ lower surface of the dielectric substrate. Referring to Fig. 9, a radiation characteristic of the antenna apparatus with the structure shown in Figs. 7A, 7B, and 8 will be described below. As illustrated in Fig. 9, the conductor cover 44 according to the present invention improves the radiation characteristic in the horizontal direction although the sensitivity at a peak point is slightly degraded, as compared with the case without the conductor cover.

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Please amend the paragraph at page 8, line 16 to page 9,
line 1 as follows:

The radiation element 31 is placed inside the dielectric substrate 52 at its center portion and has, on an X-Y plane, a six-sided or a hexagonal shape as described in conjunction with Fig. 5A. The radiation element 31 has a transversal length L_p of about 47.7mm. The distance h_p between a ~~rear~~ lower surface of the radiation element 31 and a ~~rear~~ lower surface of the dielectric substrate 52 is equal to about 2.6mm. On each side of ~~a front~~ an upper surface of the dielectric substrate 52, the length ΔL of the cut portion is equal to about 11.9mm. The dielectric substrate 52 has a square shape on the X-Y plane, and has a side lengths L_w of about 63.6mm and a thickness h_w of about 5.1mm in a Z axis direction. The feeding lead 53 is placed on the radiation element 31 at a position d_f spaced by about 14.1mm from a center point in an X axis direction. Each of the hood portions 54W of a rectangular shape has a length l_L (in a Y axis direction) of about 18.6mm and a width l_s (in the Z axis direction) of about 12.8mm.

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Please amend the abstract on page 12 as follows:

~~Abstract of the Disclosure:~~

An antenna apparatus ~~comprises~~ includes a dielectric substrate ~~(42)~~, a radiation element ~~(31)~~ buried in the dielectric substrate, and a feeding lead ~~(43)~~ connected to the radiation element and ~~extracted~~ extending outward from the dielectric substrate. The dielectric substrate is covered with a conductor cover ~~(44)~~ except at an exposed portion left on ~~a front~~ an upper surface thereof. The conductor cover comprises a side wall portion extending in a thickness direction of the radiation element and covering all side surfaces of the dielectric substrate, and a hood portion ~~(44W)~~ extending from an upper edge of the side wall portion and ~~covers~~ covering a part of the ~~front~~ upper surface of the dielectric substrate. The hood portion ~~(44W)~~ has a trapezoidal or a rectangular shape.